

What is claimed is:

1. A control system for an internal combustion engine having a variable control mechanism that variably controls engine performance characteristics in accordance with an engine operating condition, comprising:

a detecting device that detects an operating condition of the variable control mechanism and produces a signal representative thereof; and

10 a controller that controls the operating condition of the variable control mechanism in response to the signal from the detecting device;

the controller being programmed to determine whether an operation responsiveness of the variable control mechanism is lowered based on the signal from the detecting device and vary operational characteristics of the variable control mechanism when the operation responsiveness is lowered.

20 2. A control system for an internal combustion engine having a variable valve operating mechanism capable of varying at least one of a valve lift and an operation angle of an engine valve continuously, comprising:

25 a detecting device that detects an operating condition of the variable valve operating mechanism and produces a signal representative thereof; and

a controller that controls the operating condition of the variable valve operating mechanism in response to the signal from the detecting device;

30 the controller being programmed to determine whether an operation responsiveness of the variable valve operating mechanism is lowered based on the

signal from the detecting device and vary operational characteristics of the variable valve operating mechanism when the operation responsiveness of the variable valve operating mechanism is lowered.

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3. A control system according to claim 2, wherein the controller is programmed to make a diagnosis of the operation responsiveness of the variable valve operating mechanism during operation of the engine.

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4. A control system according to claim 2, wherein the controller is programmed to make a diagnosis of the operation responsiveness of the variable valve operating mechanism immediately after start of the engine.

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5. A control system according to claim 2, wherein the engine is of an V-type and has the variable valve operating mechanism at each of banks thereof, the controller being programmed to determine whether the operation responsiveness of the variable valve operating mechanism at each of the banks is lowered.

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6. A control system according to claim 5, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, the controller being programmed to determine whether the operation responsiveness of the variable valve operating mechanism is lowered based on a difference between a target rotational angle and an actual rotational angle of the control

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shaft of the variable valve operating mechanism at each of the banks.

7. A control system according to claim 5, wherein
5 the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, the controller being programmed
10 to determine whether the operation responsiveness of the variable valve operating mechanism is lowered based on a difference in a angular velocity of the control shaft between the banks.

15 8. A control system according to claim 2, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and
20 the operation angle, the controller being programmed to determine whether the operation responsiveness of the variable valve operating mechanism is lowered based on a holding energy of the actuator for holding the control shaft at a target rotational angle when a
25 target rotational angle of the control shaft is held constant for a predetermined period of time.

9. A control system according to claim 2, wherein
the variable valve operating mechanism includes an
30 actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, the controller being programmed

to determine whether the operation responsiveness of the variable valve operating mechanism is lowered based on a delay in variation of an actual rotational angle of the control shaft in response to a variation of a target rotational angle when the target rotational angle is varied by an amount equal to or larger than a predetermined value.

10. A control system according to claim 2, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, the control system further comprising a detecting device for detecting a temperature of the actuator, the controller being programmed to determine the operation responsiveness of the variable valve operating mechanism based on the temperature of the actuator.

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11. A control system according to claim 2, further comprising a warning lamp that is turned on when a deterioration parameter indicative of a degree of deterioration of the actuator becomes larger than a predetermined value.

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12. A control system according to claim 2, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, the controller being programmed to limit the rotational angle of the control shaft and

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thereby make smaller one of the valve lift and the operation angle when the operation responsiveness of the variable valve operating mechanism is lowered

5 13. A control system according to claim 12, wherein limitation of the rotational angle of the control shaft is attained by varying a holding energy of the actuator for holding the control shaft at a target rotational angle.

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14. A control system according to claim 12, wherein the controller is programmed to generate a map for setting a rotational angle limit of the control shaft in accordance with engine speed when the operation
15 responsiveness of the variable valve operating mechanism is lowered.

15. A control method for an internal combustion engine having a variable valve operating mechanism
20 capable of varying at least one of a valve lift and an operation angle continuously, the method comprising:

detecting an operating condition of the variable valve operating mechanism and producing a signal representative thereof by means of a detecting device;
25 and

controlling the operating condition of the variable valve operating mechanism in response to the signal from the detecting device;

the controlling including determining whether an
30 operation responsiveness of the variable valve operating mechanism is lowered based on the signal from the detecting device and varying operational characteristics of the variable valve operating

mechanism when the operation responsiveness of the variable valve operating mechanism is lowered.

16. A control method according to claim 15, wherein
5 the controlling comprises making a diagnosis of the operation responsiveness of the variable valve operating mechanism during operation of the engine.

17. A control method according to claim 15, wherein
10 the controlling comprises making a diagnosis of the operation responsiveness of the variable valve operating mechanism immediately after start of the engine.

18. A control method according to claim 15, wherein
15 the engine is of an V-type and has the variable valve operating mechanism at each of banks thereof, and the controlling comprises determining whether the operation responsiveness of the variable valve
20 operating mechanism at each of the banks is lowered.

19. A control method according to claim 18, wherein
the variable valve operating mechanism includes an actuator and a control shaft that is driven by the
25 actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, and the controlling comprises determining whether the operation responsiveness of the variable valve operating mechanism is lowered
30 based on a difference between a target rotational angle and an actual rotational angle of the control shaft of the variable valve operating mechanism at each of the banks.

20. A control method according to claim 18, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, and the controlling comprises determining whether the operation responsiveness is lowered based on a difference in a angular velocity of the control shaft between the banks.

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21. A control method according to claim 15, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, and the controlling comprises determining whether the operation responsiveness of the variable valve operating mechanism is lowered based on a holding energy of the actuator for holding the control shaft at a target rotational angle when a target rotational angle of the control shaft is held constant for a predetermined period of time.

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22. A control method according to claim 15, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and the operation angle, and the controlling comprises determining whether the operation responsiveness of the variable valve operating mechanism is lowered based on a delay in variation of an actual rotational angle of the control shaft in response to a variation

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of a target rotational angle when the target rotational angle is varied by an amount equal to or larger than a predetermined value.

5 23. A control method according to claim 15, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and
10 the operation angle, the control method further comprises detecting a temperature of the actuator, and the controlling comprises determining the operation responsiveness of the variable valve operating mechanism based on the temperature of the actuator.

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24. A control method according to claim 15, further comprising turning on a warning lamp when a deterioration parameter indicative of a degree of deterioration of the actuator becomes larger than a
20 predetermined value.

25. A control method according to claim 15, wherein the variable valve operating mechanism includes an actuator and a control shaft that is driven by the actuator so as to vary in a rotational angle thereof and thereby variably control one of the valve lift and
25 the operation angle, and the controlling comprises limiting the rotational angle of the control shaft and thereby making smaller one of the valve lift and the operation angle when the operation responsiveness of
30 the variable valve operating mechanism is lowered.

26. A control method according to claim 25, wherein
the limiting of the rotational angle of the control
shaft comprises varying a holding energy of the
actuator for holding the control shaft at a target
5 rotational angle.

27. A control method according to claim 25, wherein
the controlling comprises generating a map for setting
a rotational angle limit of the control shaft in
10 accordance with engine speed when the operation
responsiveness of the variable valve operating
mechanism is lowered.

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